

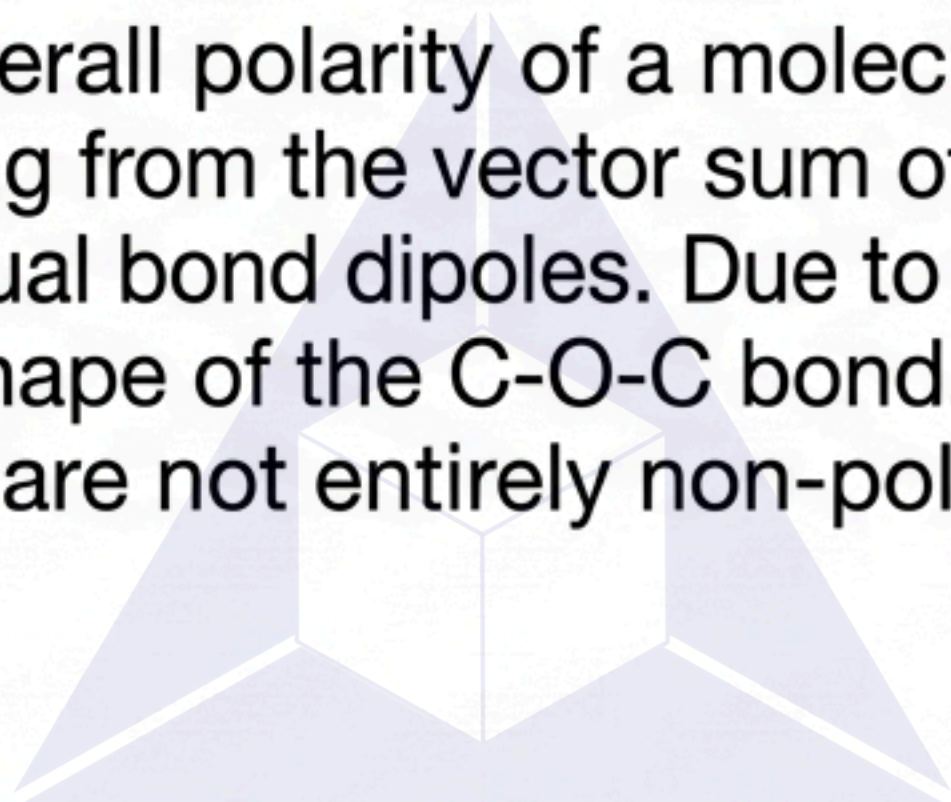
UNIT 7 • ALCOHOLS, PHENOLS AND ETHERS

Physical Properties of Ethers

The 'Dual Personality' of Ethers: Boiling points of an alkane, solubility of an alcohol.

NET DIPOLE MOMENT

The overall polarity of a molecule resulting from the vector sum of its individual bond dipoles. Due to the bent shape of the C-O-C bond, ethers are not entirely non-polar.



WEAK POLARITY

Ethers possess a small net dipole, but it is too weak to significantly impact intermolecular forces between pure ether molecules.

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Boiling Point: Acting Like an Alkane



Weak polarity barely affects boiling point. Without the ability to hydrogen-bond with themselves, ethers boil at almost the exact same temperature as alkanes of comparable mass.



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$$E=mc^2$$



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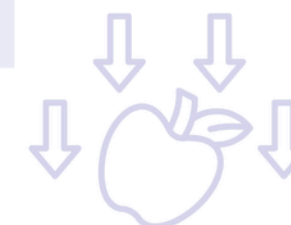
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Water Solubility: Acting Like an Alcohol

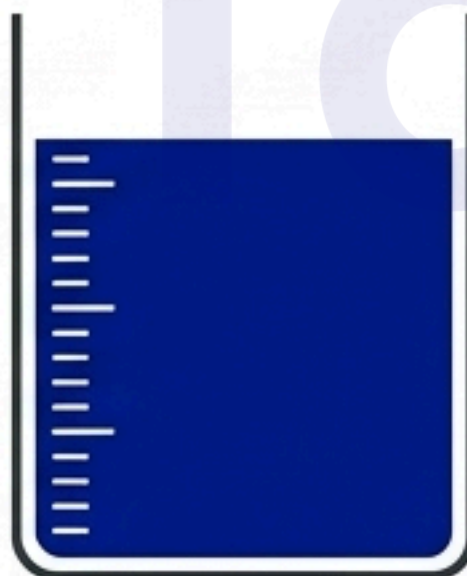
n-Pentane

Immiscible



Ethoxyethane

7.5 g / 100mL



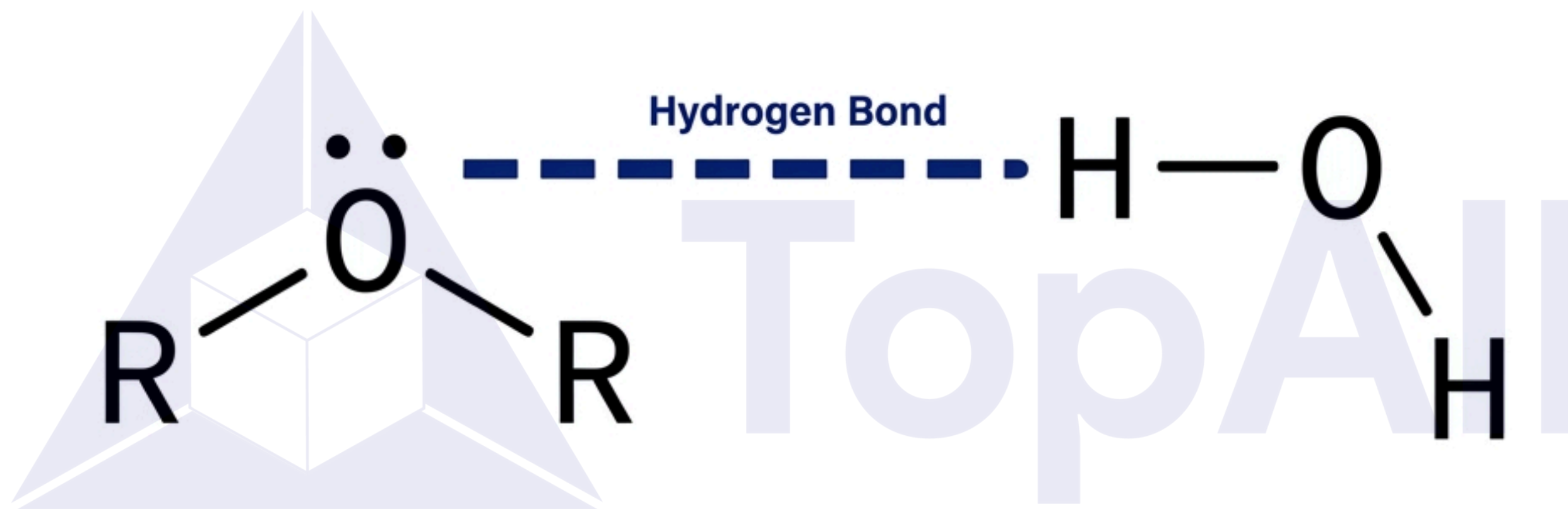
Butan-1-ol

9.0 g / 100mL



Despite low boiling points, ether miscibility resembles alcohols of the same molecular mass. **How is this possible?**

The Oxygen Advantage



Ethers cannot hydrogen-bond with **themselves** (hence the low boiling point). But the oxygen atom in an ether has lone pairs that CAN form hydrogen bonds with **water molecules**—unlocking high solubility.

The Polarity Paradox

Do not conflate the effects of weak polarity. Examiners will try to trick you into assuming that because an ether's polarity is too weak to raise its boiling point, it must also be completely insoluble in water.

Weak polarity = Negligible BP effect.

Oxygen lone pairs = Meaningful solubility effect.

Key Takeaways

- **Boiling Point:** Comparable to alkanes. Ethers lack the hydrogen atoms necessary to form intermolecular H-bonds with themselves.
- **Solubility:** Comparable to alcohols. The ether oxygen contains lone pairs that successfully form hydrogen bonds with water molecules, making them highly miscible.



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